Land Navigation Course

Corrections and New Course Registration using GPS and Lane Selection Tools

Markus Craig & Jonathan Brown
NE-ARNG

DoD Specifications

- General guidance* provided by:
  - FM 3-25.26 (chapter 14 & appendix F)
  - Source: Infantry School; Fort Benning, GA
- *Specific standards prescribed by Unit Commander
  - De facto unit commander for all NCOA land navigation courses is the Sergeant Majors Academy!

DoD / SGM Academy Specifications

- True point locations within 50 meters of given test coordinates.
- Coordinates in UTM: WGS84 or NAD83.
- Every point greater than 100 meters from all other points.
- Lane lengths between 600 and 800 meters.
- Signage requirements. (visibility)

Navigation Courses

- Verification of existing compass course: Camp Ashland Training Site (CATS)
- Creation of multi-user course: Mead Training Site (MTS)
  - Can support 100 trainees simultaneously
- Lane Selection Tool

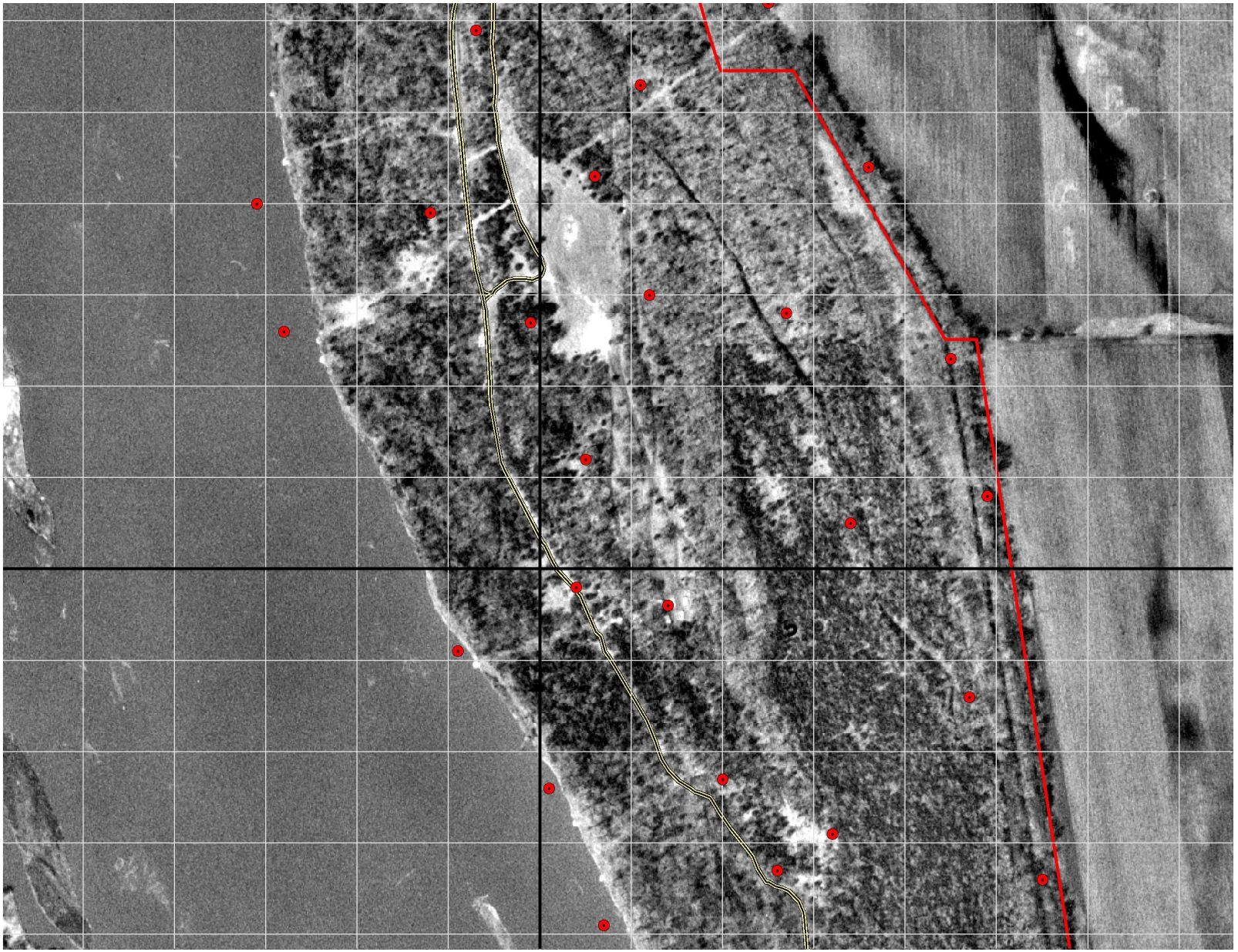
Camp Ashland Navigation Course

- Problem:
  - Navigation Course at Camp Ashland was not within certification requirements (SGM Academy)
    - Some given point coordinates >85 meters off & in river
  - RTI de-certification possible

GPS / GIS Specifications & Resources

- ESRI: Arcview 3.2
  - Dell Workstation / NT 4.0
- Bearing & Distance Extension
  - ESRI; ArcScripts website
- Trimble Pro-XRS GPS
  - Omnistar satellite correction signal
  - Sub-meter accuracy (approx. +or- .3 meter)
- Trimble: Pathfinder Office 2.51
  - GPS data download & GIS exports

Plotted Nav Coordinates



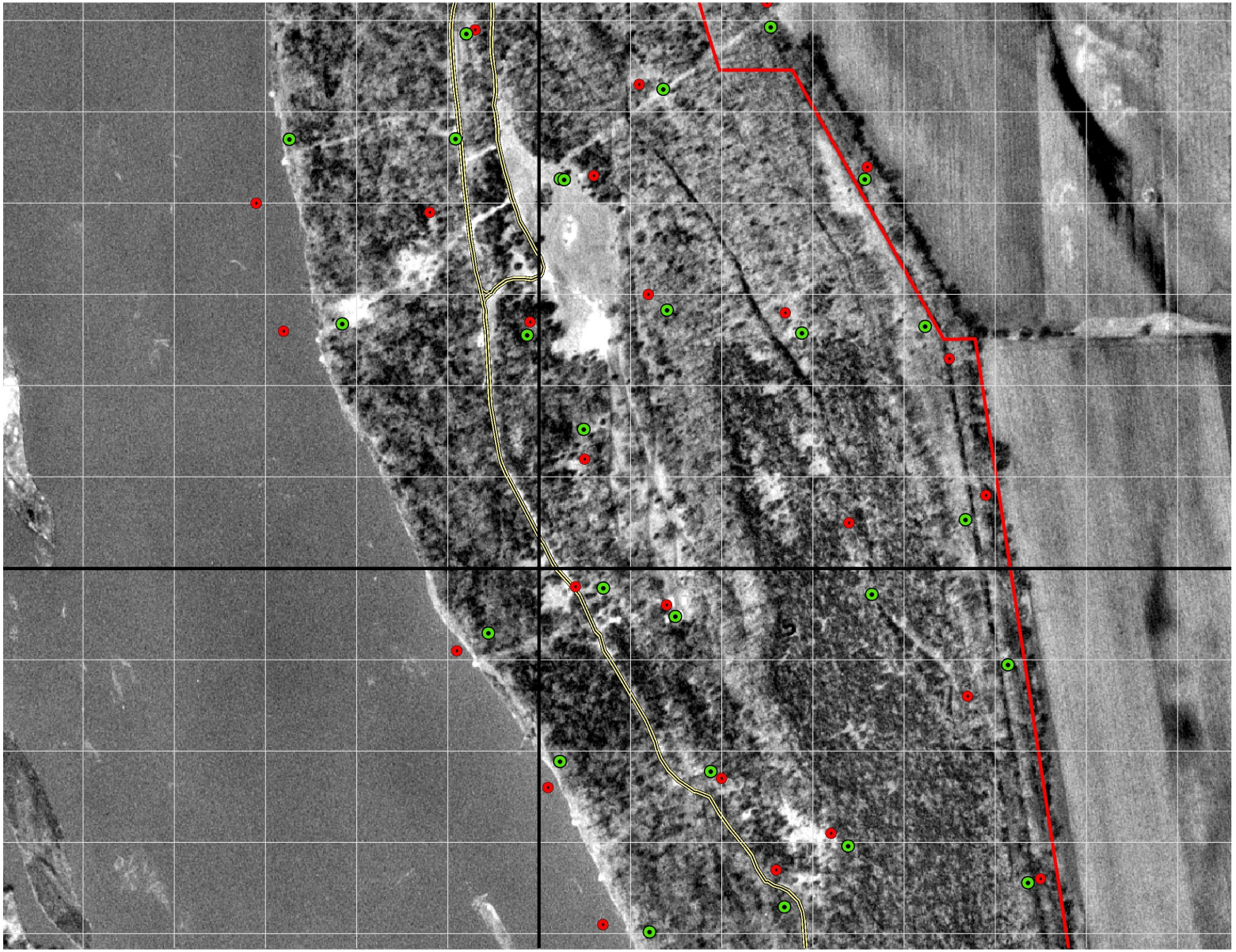
Process:

- GPS used to map course point locations
- Points downloaded to Pathfinder Office
  - Exported as Shapefile
    - option of integral northing and easting attributes
    - or add X Y extension / scripting
- Distances & bearings processed in GIS and exported as individual worksheets
  - Select point, run extension, export worksheet
  - Repeat for each point

Process (cont'd):

- Worksheets assembled into Access Database
  - Each table represents one point with bearings and distances to all other points on the course.
- Database provided to RTI & processed with "Lane Selection Tool"

Old Coord's Red / New Green



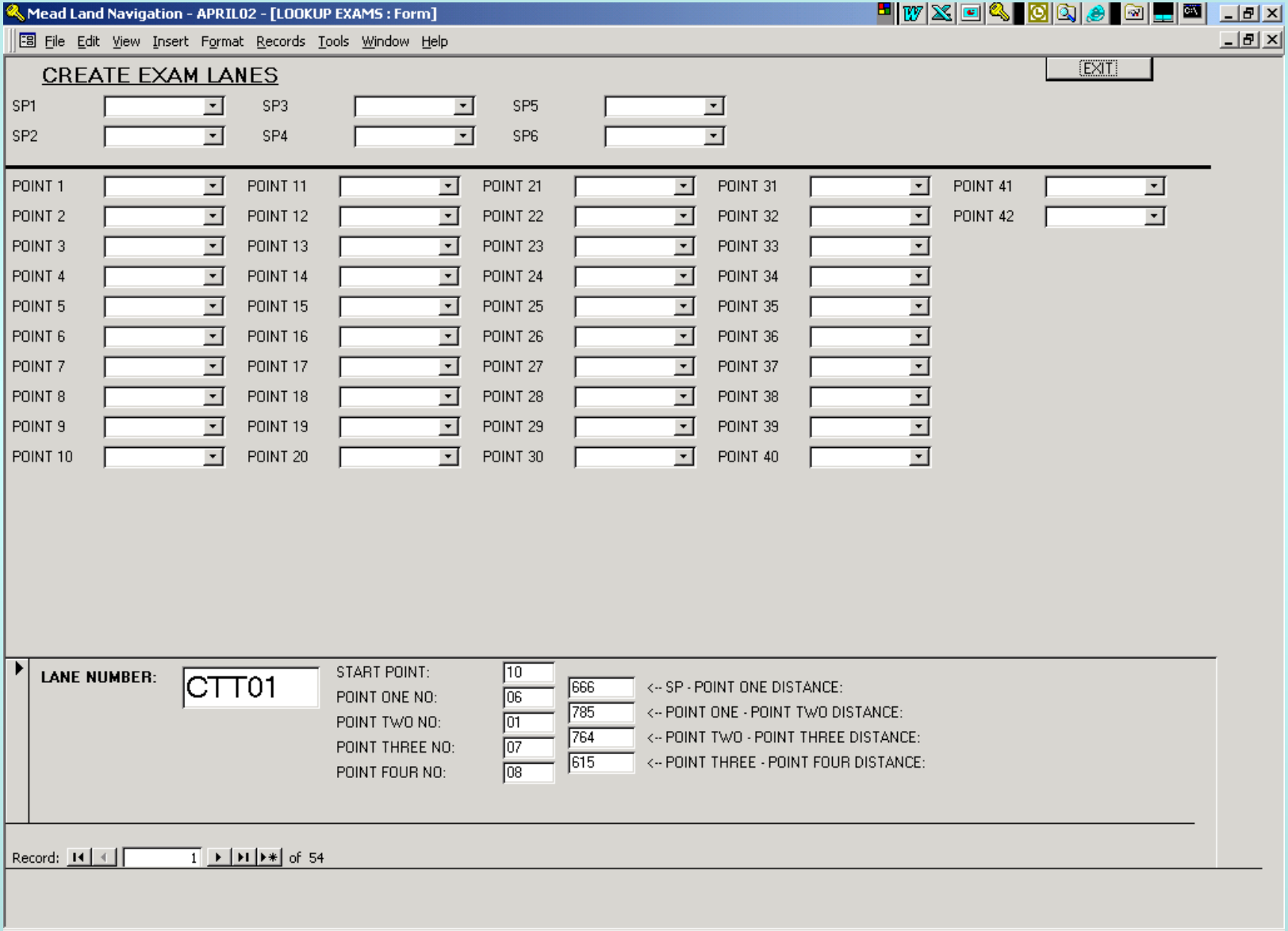
Lane Selection Tool

- (Access) Macros to select lanes within desired specifications.
- Set up min - max distance parameters.
- Select start point.
- Tool queries start point table within database and provides all other points within desired distances.
- Choose next point - repeat process
  - Auto drop down of chosen points

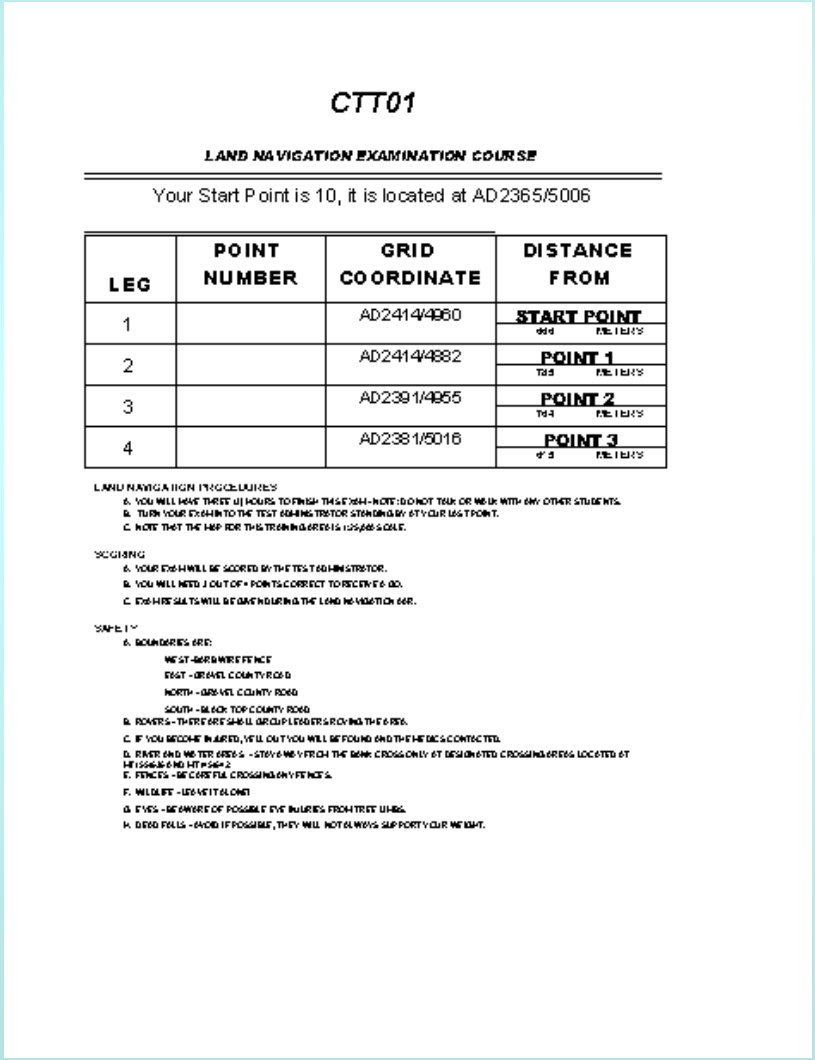
Lane Selection Tool

Mead Land Navigation - APRIL02 - [INDEX : Form]
File Edit View Insert Format Records Tools Window Help
209TH TRAINING REGIMENT (RTI-NE) LAND NAVIGATION MANAGEMENT SYSTEM
LAND NAV EXAM MANAGEMENT
CREATE EXAM LANES
CREATE EXAM LANE
PRINT EXAMINATION SHEETS
PRINT EXAMINATIOIN ANSWER KEYS
PRINT LAND NAV PRACTICE SHEETS
<-- USE START POINT 16 ONLY
PRINT LAND NAV PRACTICE ANSWER KEYS
<-- USE START POINT 16 ONLY
PRINT MASTER LANE LISTING
EXIT TO WINDOWS
Record: 1 of 1

Create Exercise Lanes



Print Exam Sheets & Answer Keys



CTT01

LAND NAVIGATION EXAMINATION COURSE

Your Start Point is 10, it is located at AD2365/5006

LEG	POINT NUMBER	GRID COORDINATE	DISTANCE FROM
1		AD2414/4960	**START POINT** 484 METERS
2		AD2414/4882	**POINT 1** 788 METERS
3		AD2391/4955	**POINT 2** 744 METERS
4		AD2381/5016	**POINT 3** 473 METERS

LAND NAVIGATION PROCEDURES

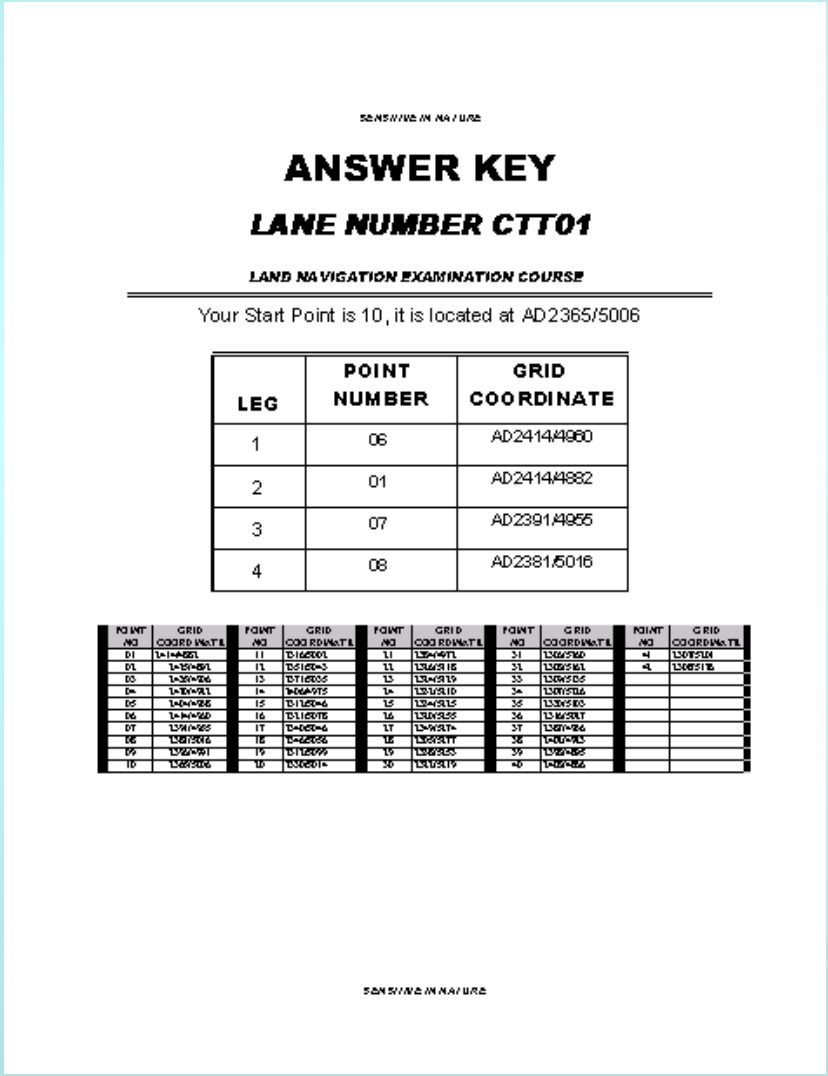
A. YOU WILL HAVE THREE (3) HOURS TO FINISH THIS EXAM - NOTE: DO NOT TALK OR WALK WITH ANY OTHER STUDENTS.
B. TURN YOUR EXAM IN TO THE TEST ADMINISTRATOR STANDING BY AT YOUR LAST POINT.
C. NOTE THAT THE MAP FOR THIS TRAINING AREA IS 1:25,000 SCALE.

SCORING

A. YOUR EXAM WILL BE SCORED BY THE TEST ADMINISTRATOR.
B. YOU WILL NEED 3 OUT OF 4 POINTS CORRECT TO RECEIVE A GO.
C. EXAM RESULTS WILL BE GIVEN DURING THE LAND NAVIGATION AAR.

SAFETY

A. BOUNDARIES ARE:
   WEST - BARBWIRE FENCE
   EAST - GRAVEL COUNTY ROAD
   NORTH - GRAVEL COUNTY ROAD
   SOUTH - BLACK TOP COUNTY ROAD
B. ROVERS - THERE ARE SMALL GROUPS OF SOLDIERS ROVING THE AREA.
C. IF YOU BECOME INJURED, YELL OUT YOU WILL BE FOUND AND THE MEDICS CONTACTED.
D. RIVER AND WATER AREAS - STAY AWAY FROM THE BANK CROSS ONLY AT DESIGNATED CROSSING AREAS LOCATED AT MI5568364 AND MI5684
E. FENCES - BE CAREFUL CROSSING ANY FENCES.
F. WILDLIFE - LEAVE IT ALONE!
G. EYES - BEWARE OF POSSIBLE EYE INJURIES FROM TREE LIMBS.
H. DEAD FALLS - AVOID IF POSSIBLE, THEY WILL NOT ALWAYS SUPPORT YOUR WEIGHT.



SENSITIVE IN NATURE

ANSWER KEY

LANE NUMBER CTT01

LAND NAVIGATION EXAMINATION COURSE

Your Start Point is 10, it is located at AD2365/5006

LEG	POINT NUMBER	GRID COORDINATE
1	06	AD2414/4960
2	01	AD2414/4882
3	07	AD2391/4955
4	08	AD2381/5016

POINT NO	GRID COORDINATE	POINT NO	GRID COORDINATE	POINT NO	GRID COORDINATE	POINT NO	GRID COORDINATE	POINT NO	GRID COORDINATE
01	[illegible]	11	[illegible]	21	[illegible]	31	[illegible]	41	[illegible]
02	[illegible]	12	[illegible]	22	[illegible]	32	[illegible]	42	[illegible]
03	[illegible]	13	[illegible]	23	[illegible]	33	[illegible]		
04	[illegible]	14	[illegible]	24	[illegible]	34	[illegible]		
05	[illegible]	15	[illegible]	25	[illegible]	35	[illegible]		
06	[illegible]	16	[illegible]	26	[illegible]	36	[illegible]		
07	[illegible]	17	[illegible]	27	[illegible]	37	[illegible]		
08	[illegible]	18	[illegible]	28	[illegible]	38	[illegible]		
09	[illegible]	19	[illegible]	29	[illegible]	39	[illegible]		
10	[illegible]	20	[illegible]	30	[illegible]	40	[illegible]		

SENSITIVE IN NATURE

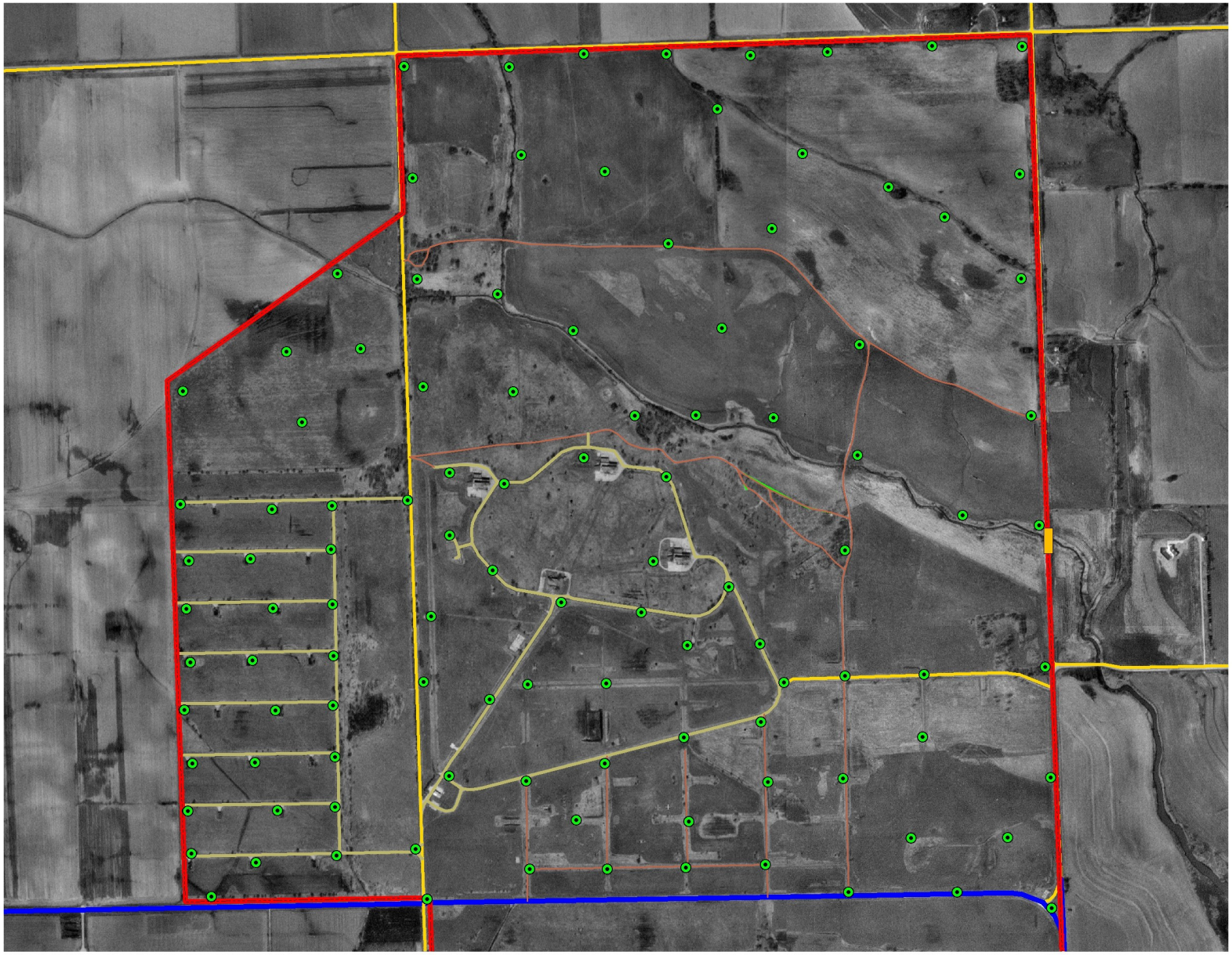
New Nav Course Development Mead Training Site

- Positions laid out in GIS using DoD criteria
- Positions transferred as waypoints to GPS & flagged on-site
- Crews place appropriate signage at flagged positions
- Re-verification & processing of final positions, distances and bearings

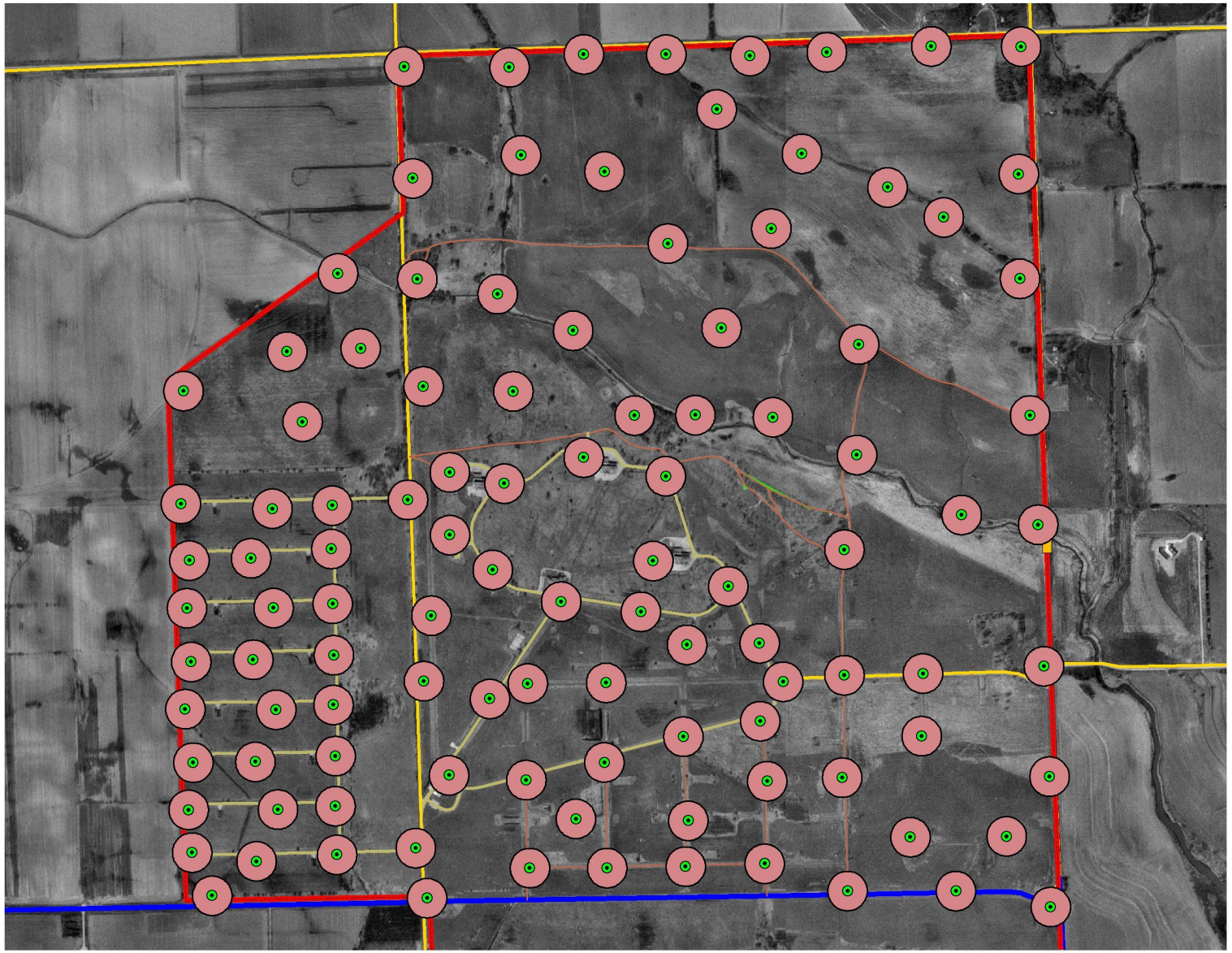
New Nav Course Development Mead Training Site

- GPS/GIS Benefits:
  - Significant savings in man-hours & tremendous increase in accuracy

Mead NAV Layout



Buffer to Verify



Worth the effort?

- Ashland and Mead Navigation Courses are now two of the most accurate test courses in DoD system…
  - Locations of points within 0.5 meters
  - Bearings to all other points within 0.1 degrees
  - Distances to all other points within 1.0 meters
- (So if you fail the confidence course, it’s nobody’s fault but your own…)

Worth the effort?

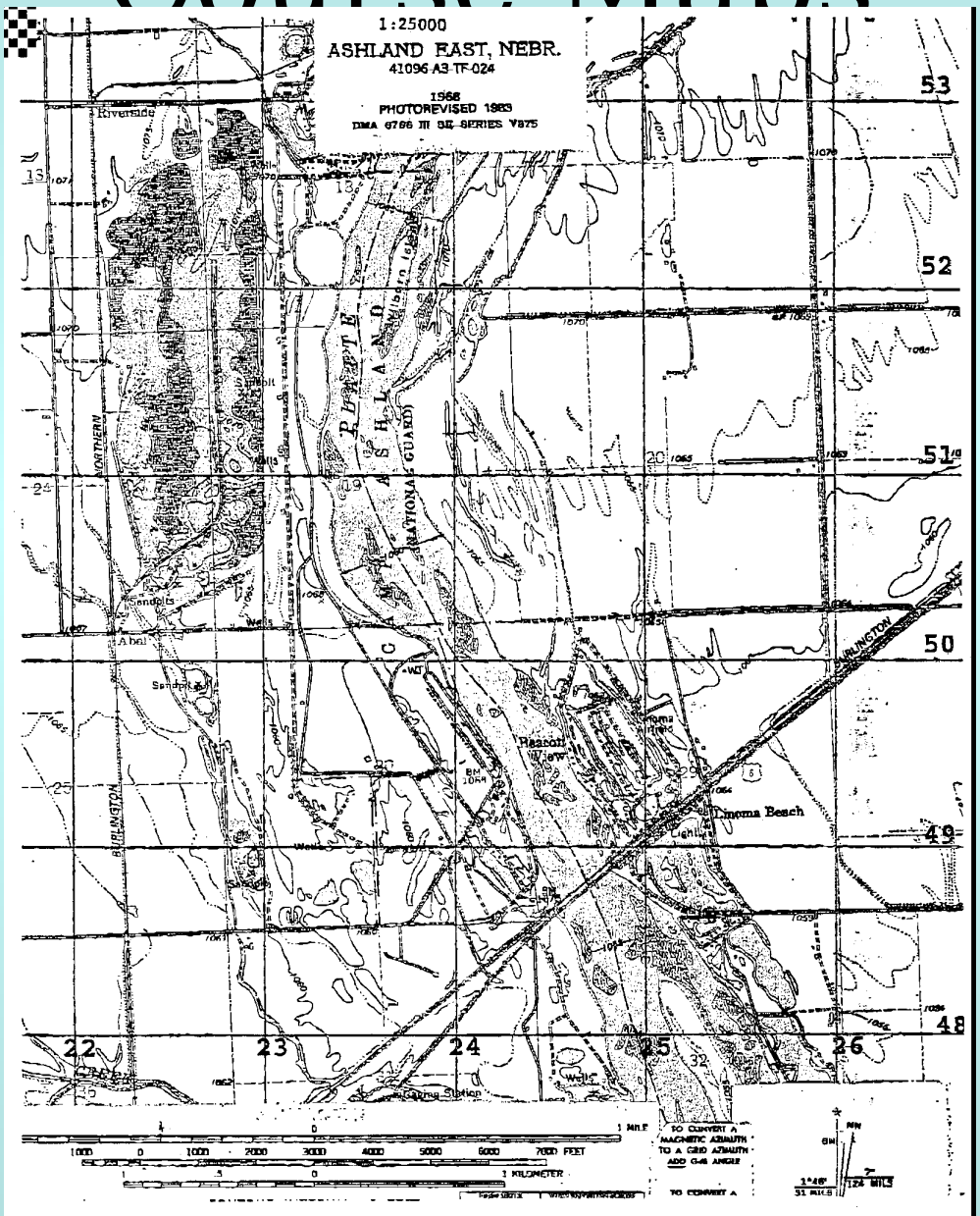
- **>50% decrease in failure rate!**

- **Significant time savings in man hours for the creation of new lanes.**

Mapping Improvements:

- Original maps of extremely poor quality
  - B & W photocopies of 1:24,000 quads with hand drawn grids & boundaries (NAD 27).

Original Navigation Course Maps



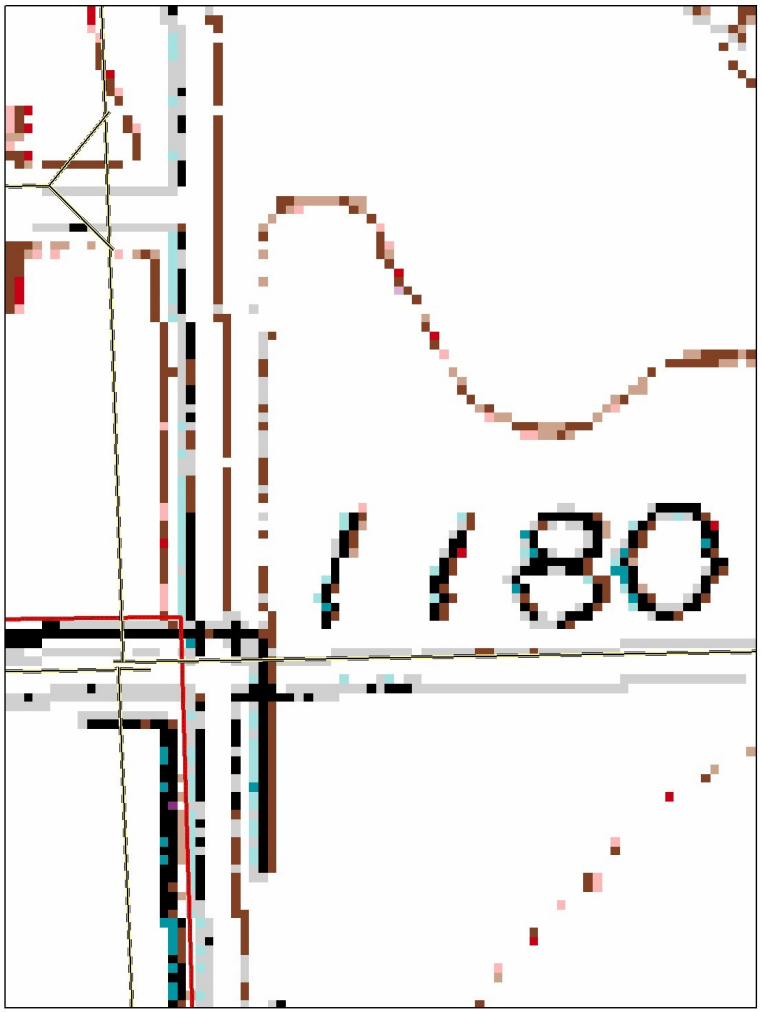
Mapping Improvements:

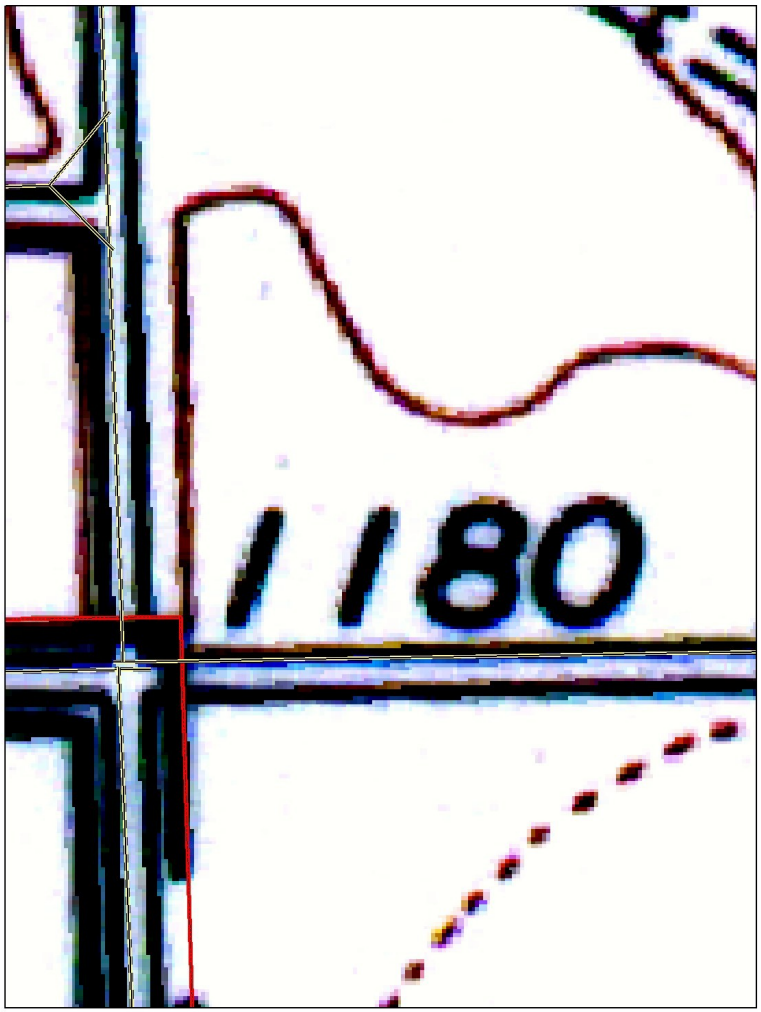
- New maps
  - High resolution Digital Raster Graphics (DRG)
  - Geo-Referenced to NAD 83
  - Grid from line coverage (NGB; ITAM-WRSC)
    - Or Graticules in Arc 8.x
  - All data GPS'd to +or- 1 foot
  - *Now (with Arc8) option of PDF output maps
    - maintains absolute scaling from any printer
      - do **not** "fit to page"!

Digital Raster Graphics (DRG)

- USGS Digital Raster Graphics often of questionable quality (re-sampling).
- New DRGs created through scanning and direct geo-referencing of USGS quadrangle maps (500dpi): NO RESAMPLING!
- Used for base maps / high-quality training site maps.
- Fully scalable in GIS

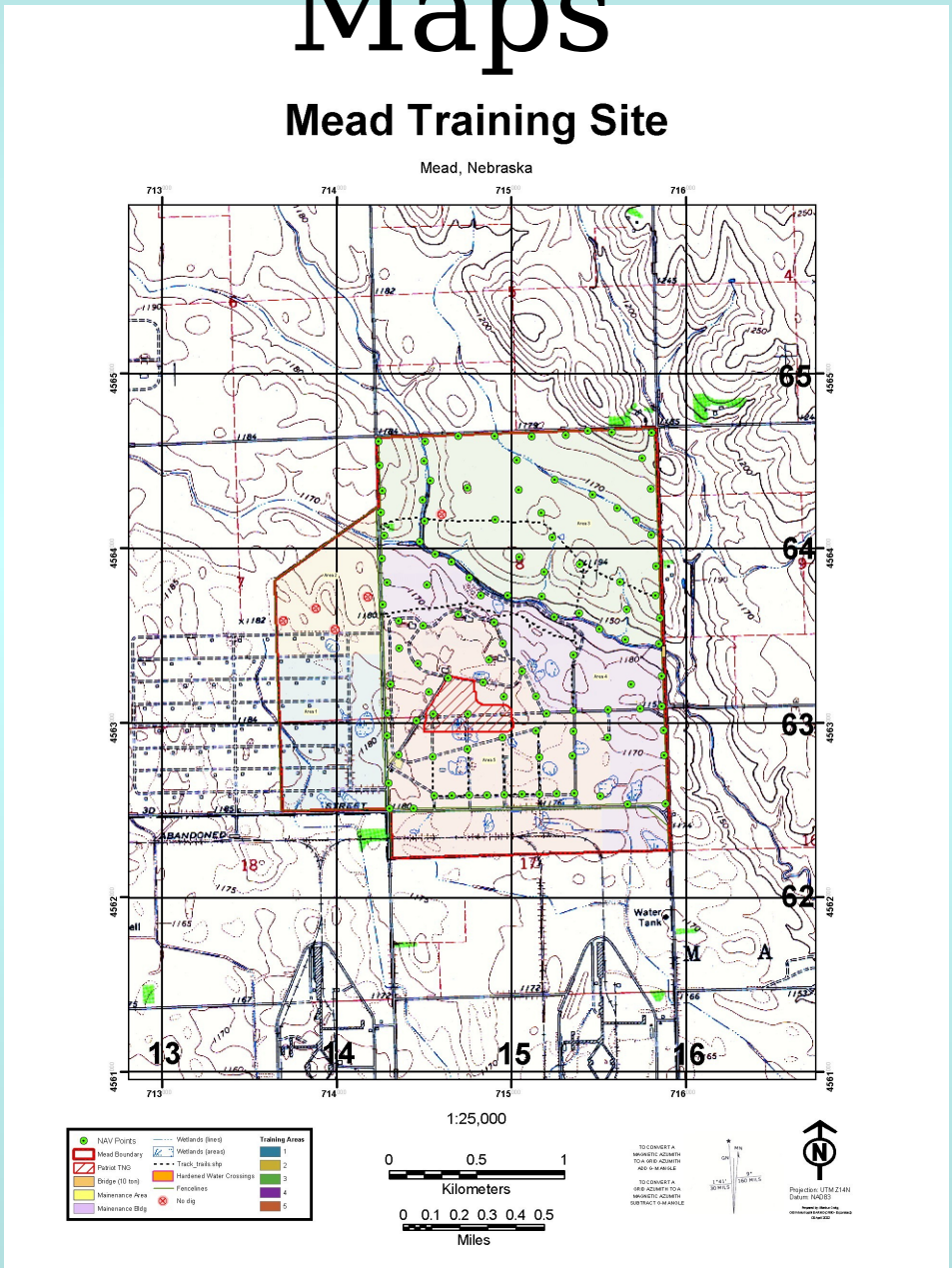
USGS vs. NEARNG DRGs





1:1,000

Improved Nav Course Maps



Conclusions:

- GIS / GPS have:
  - Greatly increased accuracy of navigation courses (> 2,000% increase in positional accuracy alone)
  - Increased quality of mapping products.
- Result: Greater success of soldiers
- Note: all projects performed in **direct support** of troops.

Questions?

Markus Craig
NE-ARNG Contract GIS Analyst
1300 Military Road
Lincoln, NE 68508

402-309-7465 (office)
402-202-3592 (cell)
279+7465 (DSN)

markus.craig@ne.ngb.army.mil